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FLOOD INSURANCE STUDY

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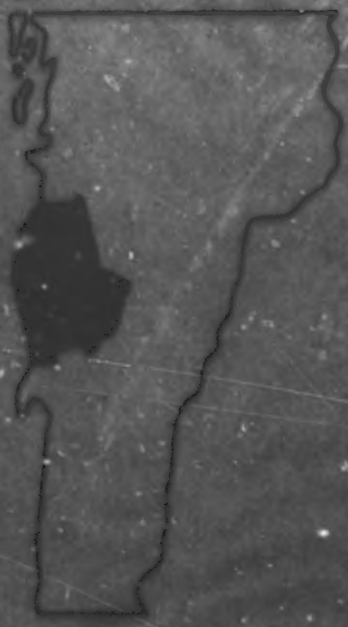

TOWN OF WALTHAM, VERMONT
ADDISON COUNTY

AUGUST 5, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER 500173

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FLOOD INSURANCE STUDY
TOWN OF WALTHAM, ADDISON COUNTY, VERMONT

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of Waltham, Addison County, Vermont, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

This Flood Insurance Study was prepared by compiling pertinent information for the flood hazard areas in the Town of Waltham from existing technical and/or scientific data originally prepared by others for purposes other than the preparation of this Flood Insurance Study. This existing data was reviewed by the Federal Emergency Management Agency (FEMA) prior to its use in the development of this Flood Insurance Study to ensure compliance with National Flood Insurance Program (NFIP) accuracy requirements.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses in this study represent a revision of the original analyses prepared for the Federal Emergency Management Agency (FEMA). The updated hydrologic analysis for Otter Creek was performed by the New York District of the U. S. Army Corps of Engineers (COE) during the preparation of a Flood Plain Technical Services report for the creek. The updated hydraulic analysis for Otter Creek was performed by DuBois & King, Inc., under subcontract to the COE as part of the same report for Otter Creek. The COE report was completed in January 1985.

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1.3 Coordination

On August 27, 1985, the results of the study were reviewed at a final Consultation and Coordination Officer's (CCO) meeting attended by representatives of FEMA and the Town of Waltham.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Town of Waltham, Addison County, Vermont. The area of study is shown on the Vicinity Map (Figure 1).

Otter Creek was studied by detailed methods for its entire length within the community. The areas studied by detailed methods were selected based upon the extent and validity of available existing hydrologic and hydraulic data.

2.2 Community Description

The Town of Waltham is located in the northwestern portion of Addison County in western Vermont. It is bordered by the Town of Ferrisburg and the City of Vergennes to the north, the Towns of Panton and Addison to the west, and the Town of New Haven to the south and east. The population of Waltham is approximately 400, and it has a land area of 5,696 acres (Reference 1).

2.3 Principal Flood Problems

Flood problems along Otter Creek are generally associated with spring runoff and summer thunderstorms. Ice jams have not been known to be a problem in the past, and they were not considered in this study.

2.4 Flood Protection Measures

There are no flood protection measures in the Otter Creek watershed.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected

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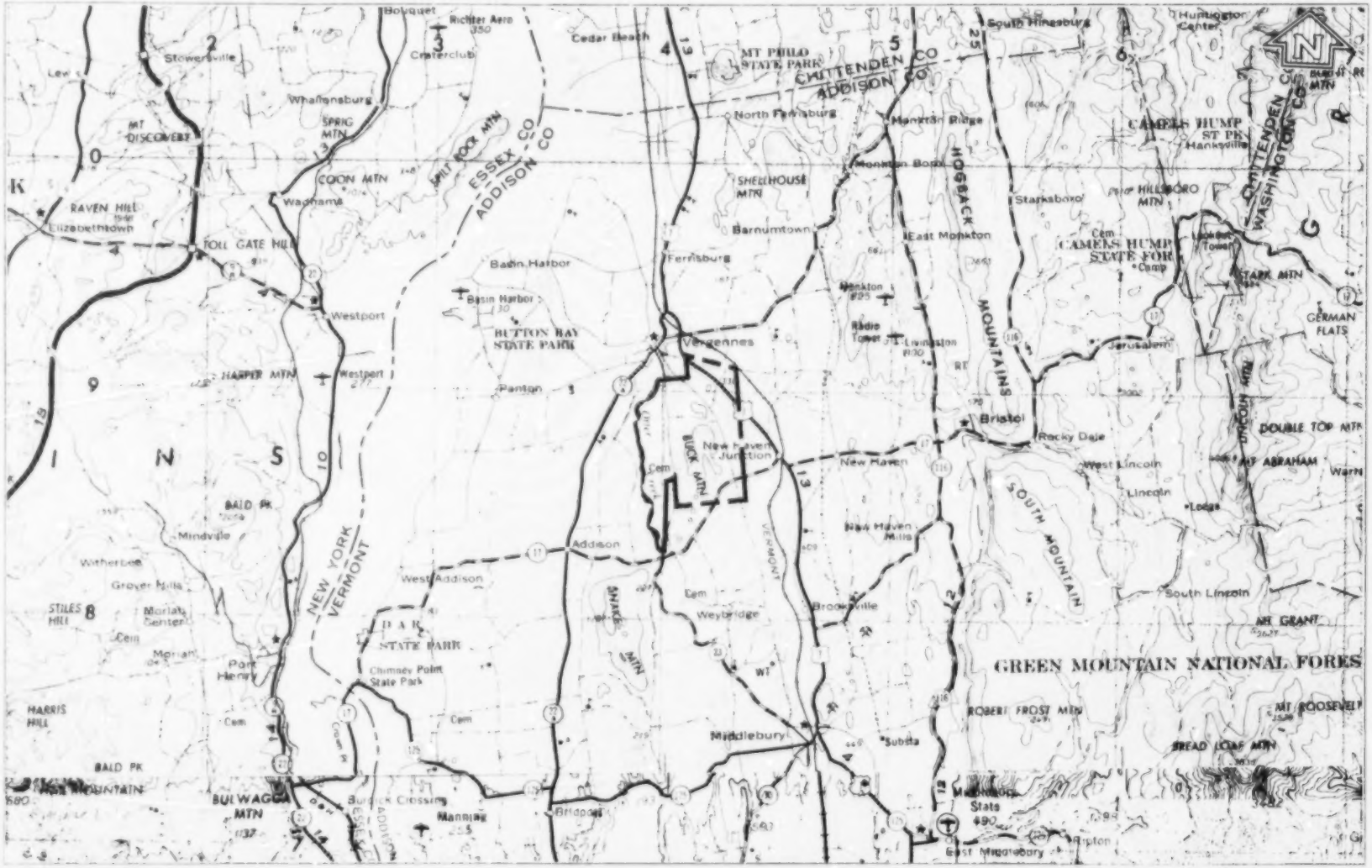

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WALTHAM, VT

(ADDISON CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

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to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding source studied in detail affecting the community.

Discharges for Otter Creek were obtained from the COE Flood Plain Technical Services report for Otter Creek (Reference 2). In the COE report, discharges were developed through an analysis of the peak discharge versus frequency curve for the U. S. Geological Survey (USGS) stream gage located at Middlebury, Vermont, which is upstream of Waltham (Reference 3). A log-Pearson Type III statistical analysis, as outlined by Water Resources Council Bulletin 17A, was performed for the water year peaks (Reference 4). The periods of record for the Middlebury gage were 1904 to 1906, 1911 to 1919, November 1927, and 1929 to 1983. The derived mean, standard deviation, and skew were 3.649, 0.148, and 0.259, respectively. The regional skew was determined to be 0.2, and the final adopted skew was calculated as 0.2. Based on physical similarity between the Middlebury site and the Waltham study site, a drainage area ratio to the 0.75 power was used to translate flood peaks to the downstream sites, to a location above Dead Creek approximately 3 miles above the mouth of Otter Creek. For Dead Creek flood peaks, a synthetic flood frequency relation was developed, and the coincidental flows from Dead Creek were determined through unit hydrograph analysis (Reference 5).

A summary of discharges for Otter Creek is shown in Table 1, "Summary of Discharges."

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TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
OTTER CREEK					
Below Lemon Fair River	866	8,908	12,114	13,616	17,306

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the flooding source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross-section information was obtained through field measurements. Bridge plans were used to obtain structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 6). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for Otter Creek were based on the mean high lake level at its confluence with Lake Champlain.

Roughness coefficients (Manning's "n") used in the hydraulic computations were estimated by field inspection at each cross section. The channel "n" values for Otter Creek ranged from 0.040 to 0.050, and the overbank "n" values ranged from 0.060 to 0.120.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

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4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year flood plain boundaries and 100-year floodway to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at scales of 1:24,000 and 1:62,500 with a contour interval of 20 feet (References 7 and 8).

The 100- and 500-year flood plain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year flood plain boundary corresponds to the boundary of the areas of special flood hazards (Zone AE), and the 500-year flood plain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this study is presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

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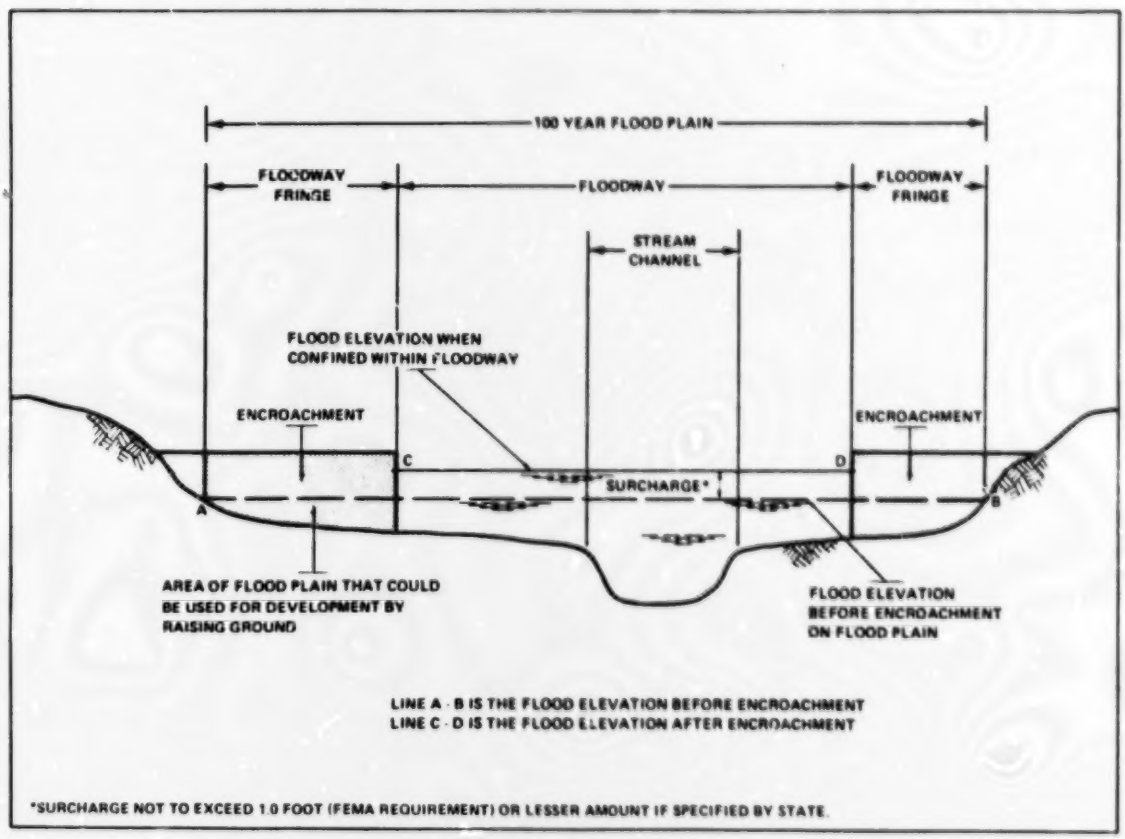
The floodway presented in this study was computed for certain stream segments on the basis of equal conveyance reduction from each side of the flood plain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 2). The computed floodway is shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary is shown. Portions of the floodway widths for Otter Creek extend beyond the corporate limits.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC

Figure 2

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Otter Creek								
A	3,500	529	5,297	2.6	142.8	142.8	143.3	0.5
B	6,880	466	5,663	2.4	143.5	143.5	144.1	0.6
C	10,180	698	6,396	2.1	144.1	144.1	144.8	0.7
D	17,180	1,012	9,416	1.4	145.4	145.4	146.3	0.9
E	20,580	502	5,574	2.4	146.1	146.1	147.1	1.0
F	24,780	196	3,719	3.7	147.4	147.4	148.3	0.9

[1]Feet above corporate limits

[2]This width extends beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WALTHAM, VT
(ADDISON CO.)

FLOODWAY DATA

OTTER CREEK

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year flood plains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown in this area.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year flood plains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year flood plain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal flood plains that have additional hazards associated with storm waves. Zone V areas are determined by approximate methods, and base flood elevations are not shown.

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Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal flood plains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year flood plain, areas within the 500-year flood plain, and to areas of 100-year shallow flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and flood plain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year flood plains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For flood plain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year flood plains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

This Flood Insurance Study was prepared by compiling existing hydrologic and hydraulic technical and scientific data prepared by other organizations originally for purposes other than the preparation of this Flood Insurance Study. The data were identified as the best available at the time of compilation of this Flood Insurance Study and should depict the general

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conditions of the flooding sources with relative accuracy. FEMA performed a cursory review and accepted the data as valid for purposes of this Flood Insurance Study and the NFIP. However, if better information is known to exist or has been developed since the date of this report, the information should be immediately forwarded to the Natural and Technological Hazards Division, Federal Emergency Management Agency (Regional Director, Region I Office, J. W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109) for consideration for revision of this study.

Flood Insurance Studies for the Towns of Ferrisburg, Panton, and Addison, and the City of Vergennes are currently being prepared (References 9, 10, 11, and 12). The results of those studies will be in complete agreement with the results of this study for Waltham.

The Flood Insurance Study for Town of New Haven is currently being revised to include the detailed analysis for Otter Creek (Reference 13). The results of that study will be in complete agreement with the results of this study.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region I Office, J. W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109.

9.0 BIBLIOGRAPHY AND REFERENCES

1. The National Survey, 1984 Vermont Yearbook, Chester, Vermont, 1984.

2. U. S. Army Corps of Engineers, New England Division, Flood Plain Technical Services, Otter Creek, Towns of Addison, Ferrisburg, New Haven, Panton, Vergennes, Waltham, and Weybridge, Addison County, Vermont, Waltham, Massachusetts, January 1985.

3. U. S. Department of the Interior, Geological Survey, National Water Data Storage and Retrieval System, Peak Flow File, Reston, Virginia, August 1979.

4. Water Resources Council, "Guidelines for Determining Flood Flow Frequency", Bulletin 17A, Washington, D. C., June 1977.

5. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-1 Flood Hydrograph Package, Davis, California, April 1980.

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6. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, April 1980.

7. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 Feet: Monkton, Vermont, Photorevised 1972; Middlebury, Vermont, 1963.

8. U. S. Department of the Interior, Geological Survey, 15-Minute Series Topographic Maps, Scale 1:62,500, Contour Interval 20 Feet: Port Henry, New York-Vermont, 1945.

9. Federal Emergency Management Agency, Flood Insurance Study, Town of Ferrisburg, Addison County, Vermont (Unpublished).

10. Federal Emergency Management Agency, Flood Insurance Study, Town of Panton, Addison County, Vermont (Unpublished).

11. Federal Emergency Management Agency, Flood Insurance Study, Town of Addison, Addison County, Vermont (Unpublished).

12. Federal Emergency Management Agency, Flood Insurance Study, City of Vergennes, Addison County, Vermont (Unpublished).

13. Federal Emergency Management Agency, Flood Insurance Study, Town of New Haven, Addison County, Vermont (Unpublished).

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EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	05	209.18	Spike set in 10-inch elm tree on west side of Hopkins Road, 30 feet from centerline, 1.55 miles south from State Route 22A intersection.
RM 2	05	138.78	Chiseled square on northwest corner of west end of box culvert, 1.25 miles from Hopkins Road south and southeast along East Road in Panton and Otter Creek Road in Addison.

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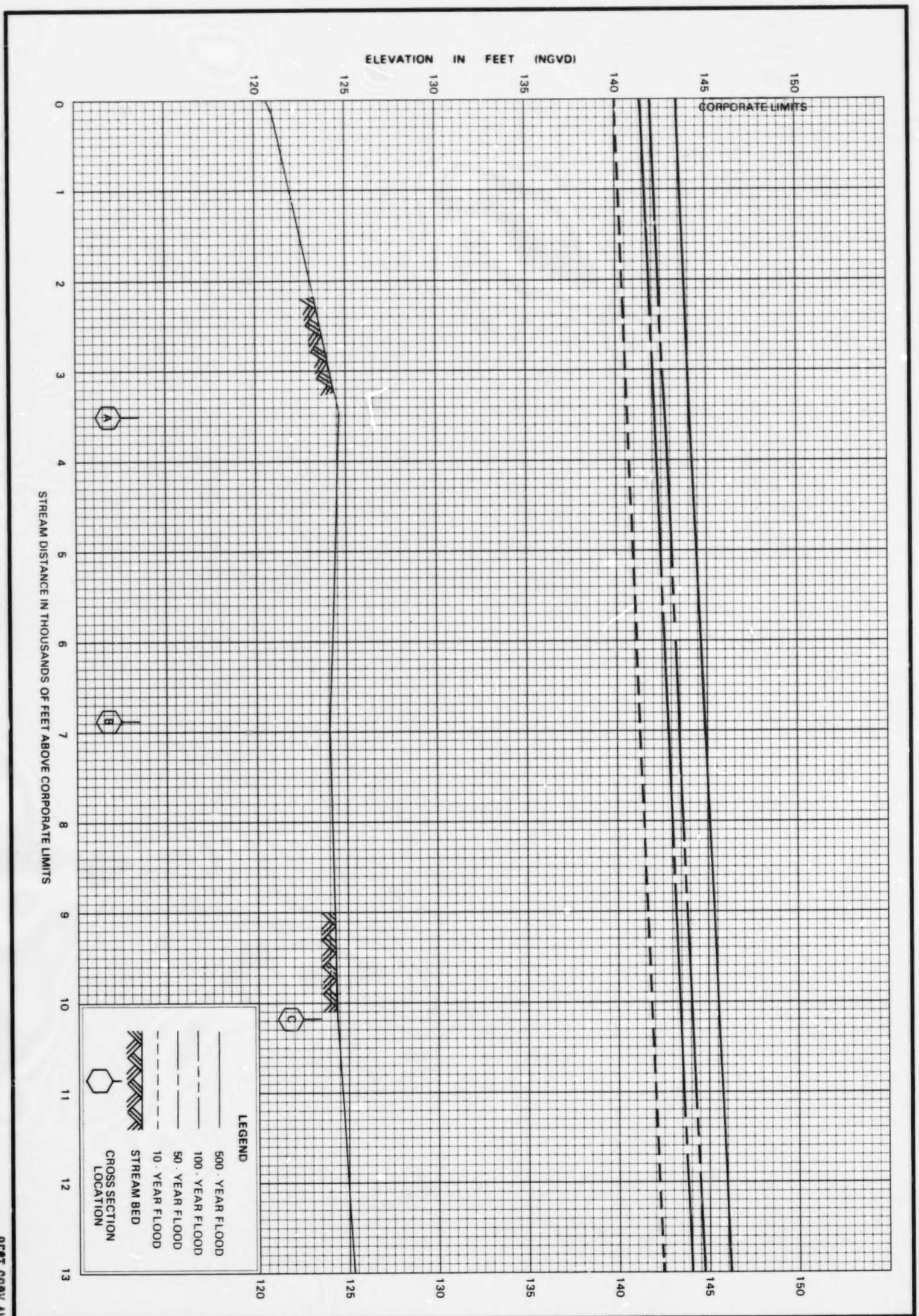

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WALTHAM, VT

(ADDISON CO.)

FLOOD PROFILES

OTTER CREEK

01P

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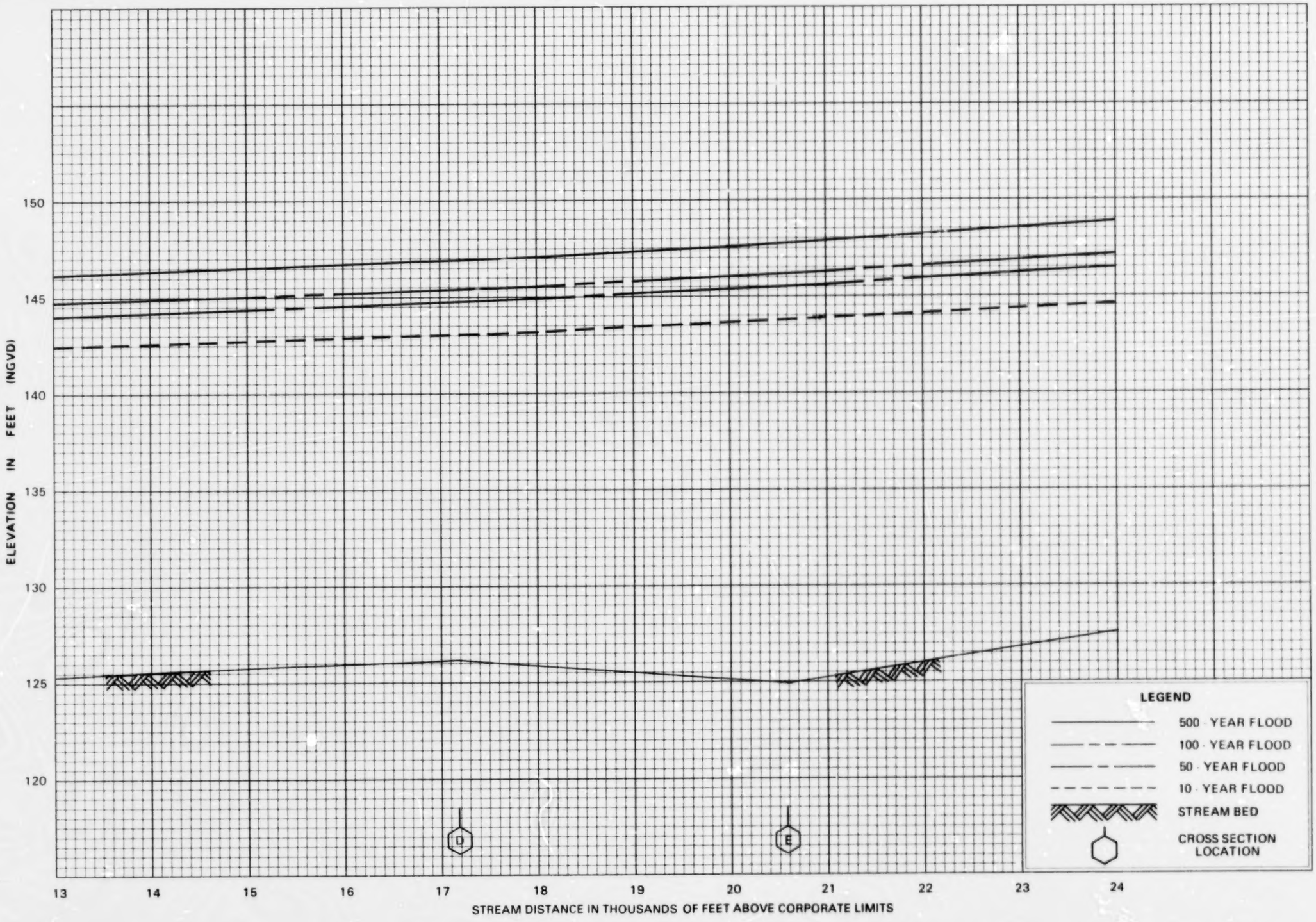

FLOOD PROFILES

OTTER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WALTHAM, VT

(ADDISON CO.)

02P

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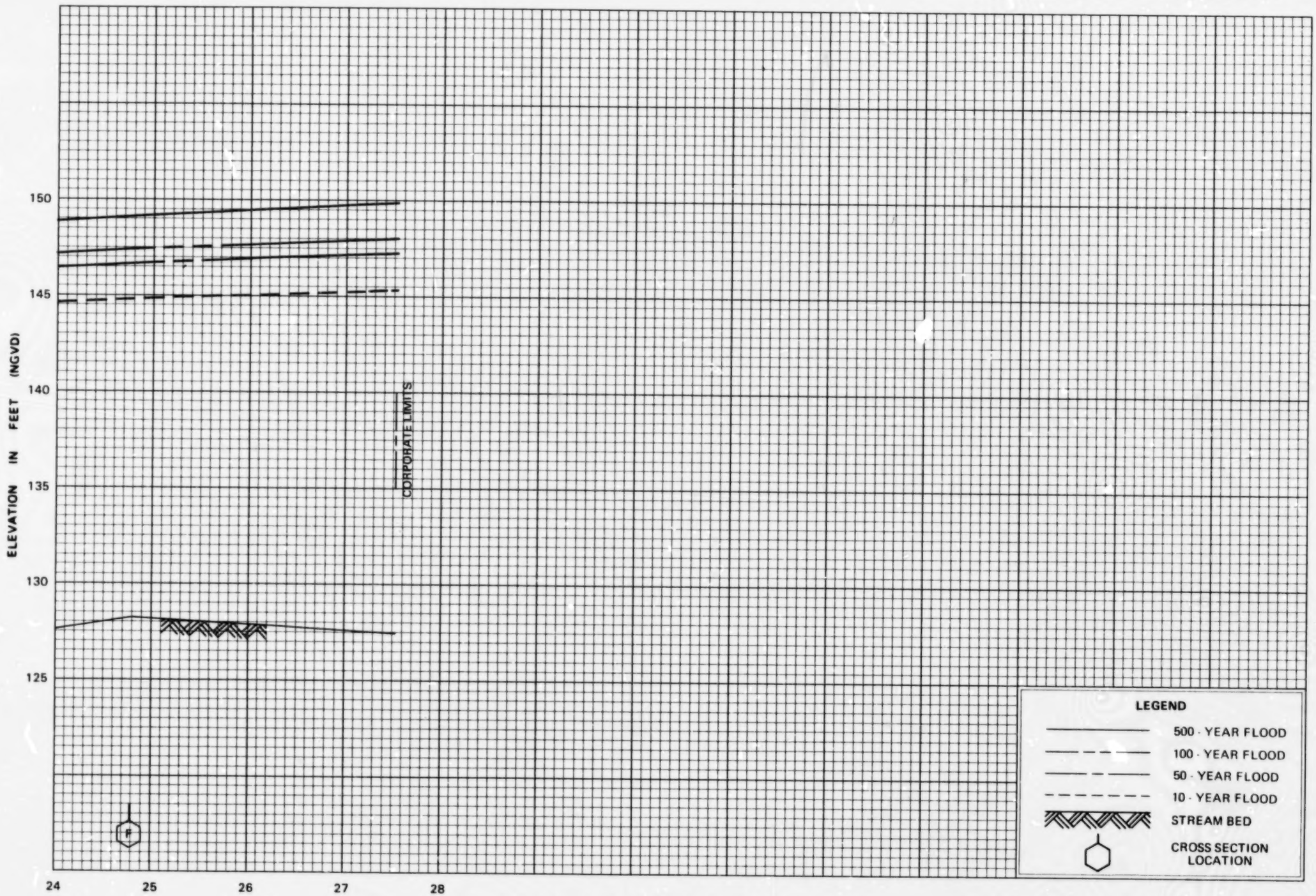

FLOOD PROFILES

OTTER CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWN OF WALTHAM, VT

(ADDISON CO.)

03P

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